REMARKS

In the Office Action, claims 1-16 and 42 were rejected under 35 USC 103(a) over USPN 6,350,431 to Snow et al. ("Snow").

Claim 42 has been amended for clarification and to present the claims in better condition for appeal. No new matter is added.

Conditional Request for Telephonic Interview

A telephonic interview is conditionally requested prior to the issuance of a subsequent Action should any issues remain after entry of this response that would delay allowance of the claims. The undersigned may be reached at (858) 587-7658.

Interview Summary

I conducted a brief telephonic interview with Examiner Asinovsky on or about April 6, 2006. I discussed with the Examiner that the argument that Snow's polyalkylene oxide was not a conjugated polymer (having delocalized π electrons, for example as in an alternating single-bond/multiple bond structure) made in the response filed Oct. 12, 2005 in this case had not been addressed in the Office Action, and that Snow did not teach or suggest this claim limitation, so obviousness could not be established. The Examiner invited me to present the argument again in a response, and to provide supporting material as appropriate. This response is filed accordingly.

The rejection under 35 USC 103(a) over USPN 6,350,431 to Snow et al. ("Snow").

Claims 1-16 and 42 were rejected under 35 USC 103(a) over Snow. This rejection is traversed.

Initially, Applicant's argument in the response filed Oct. 12, 2005 that Snow's polyalkylene oxide is not a conjugated polymer and thus not all the claim limitations are recited in the cited patent was not addressed in the Office Action. For this reason alone, obviousness has not been established because the cited art fails to provide all the claim limitations.

The attached exhibits demonstrate that Snow does not meet all the claim limitations, and thus Snow cannot establish obviousness of the claims.

Exhibit A provides the definition of a conjugated system from the Encyclopedia Brittanica online. A conjugated system is one in which "a group or chain of atoms bearing valence electrons that are not engaged in single-bond formation and that modify the behaviour of each other." A polyalkylene oxide does not meet this definition, having no valence electrons not involved in single-bond formation affecting each other.

Exhibit B provides a copy of the first page of R.H. Friend, *Pure Appl. Chem.* 73:425-430, 2001. In that reference, conjugated polymers are described as those having "delocalized π-electron bonding along the polymer chain." Page 425, last paragraph. Snow's polyalkylene oxide does not fit this definition.

Exhibit C provide a copy of the first online page of Wallace et al., Chemical Innovation 30(1):14-22, 2000. The third paragraph describes the electronic structure of conjugated polymers, in which "the electrons that constitute the π-bonds are delocalized over the entire molecule." Snow's polyalkylene oxide does not fit this definition.

Further, the Office Action asserts at page 2 that Snow describes linking moieties that can be selected from styrene, p-aminostyrene, p-aminobenzylstyrene, sodium styrene sulfonated or kinging groups including C6 phenylene groups, C7-C16 alkylenylphenylene groups and C8-C16 alkylenephenylenealkylene groups. The Office Action asserted that in light of the aromatic moiety of Snow's linking groups, the aromatic angled linkers of the claims "could be readable in Snow."

This is not a valid grounds of rejection, and does not meet the standard for establishing the presence of this claim element in the cited patent. None of these structures recites aromatic groups having angles to adjacent polymeric units required by the claims. The aromatic groups in the styrene linkers do not form part of a conjugated system, but are merely appended to a saturated nonconjugated alkylene oxide polymer. The styrene groups which form the polymer are not conjugated nor even unsaturated once polymerized.

The angled linker is described in the specification at page 17 line 3 to page 18 line 23. Page 17 lines 10-14 recite:

> The angled linker(s) are optionally substituted aromatic molecules having at least two separate bonds to other polymer components (e.g., monomers, block polymers, end groups) that are capable of forming angles relative to one another which disrupt the overall ability of the polymer to form an

> extended rigid-rod structure (although significant regions exhibiting such structure may remain.)

Snow's styrene groups do not contain aromatic molecules having at least two separate bonds to other polymer components meeting the angle limitation recited in the claims. There is no teaching or suggestion in Snow of an angled aromatic linker forming part of a conjugated polymer as claimed. Nor is there any suggestion in Snow that his optionally alkyl-derivatized phenylene groups have aromatic groups with this specific arrangement of bonds.

Furthermore, as claim 1 recites that the angled linker has bonds to its "two adjacent polymeric units which form an angle of less than about 155°" in the conjugated polymer, the single styrene or mixed alkyl/aryl linking units would not meet this claim limitation, because Snow's linkers do not link adjacent polymeric units in a conjugated polymer as claimed. Polyalkylene oxides are saturated molecules.

Additionally, the Office Action admits that Snow does not disclose an angle of less than about 155° at all. *See* page 2, last paragraph. This claim limitation is also therefore completely lacking in Snow, and no clear, specific motivation as required by caselaw has been provided for modifying Snow to meet this claim limitation has been provided. Thus the Office Action has not established *prima facie* obviousness for this reason.

As all claim limitations are not contained in the cited reference, and no motivation has been provided for modifying the cited patent towards the missing claim limitations has been provided, obviousness has not been established. Withdrawal of the rejection is respectfully requested.

The Examiner Note

The Examiner noted for the first time on page 3 of the Office Action that it was not clear what X, Y and Z were in the formula for claim 42. Although not a formal rejection, claim 42 has been amended to delete the language objected to. As this amendment is made in response to an argument raised for the first time in the Office Action, not previously presented, and presents the claims in better condition for allowance, entry of the amendment is appropriate.

Conclusion

As the claims are believed in order for allowance, a notice to that effect is respectfully requested. Should the Examiner disagree, a telephonic interview is conditionally requested prior to the issuance of a subsequent Office Action so that any remaining issues can be discussed. The undersigned may be reached at (858) 587-7658.

The Commissioner is hereby authorized to charge any underpayment or credit any overpayment associated with this communication to Deposit Account No. 06-1135 as necessary for this Response.

Respectfully submitted,

Fitch, Even, Tabin & Flannery

Date: 4/10/06

By: David Maher

David W. Maher
Reg. No. 40,077

Address all correspondence to:
USPTO CUSTOMER NO. 22242
FITCH, EVEN, TABIN & FLANNERY
120 So. LaSalle Street, Ste. 1600
Chicago, IL 60603

Direct telephone inquiries to:
David W. Maher
(858) 552-1311
San Diego, California Office of
FITCH, EVEN, TABIN & FLANNERY

conjugated system

in a covalent chemical compound, a group or chain of atoms bearing valence electrons that are not engaged in single-bond formation and that modify the behaviour of each other. If, for example, a carbonyl group (C : O) and a hydroxyl group (OH) are widely separated in a molecule, each has distinctive properties, but in combination they form the carboxyl group (COOH), which has...

Pure Appl. Chem., Vol. 73, No. 3, pp. 425–430, 2001.

Conjugated polymers. New materials for optoelectronic devices*

R. H. Friend

Cavendish Laboratory, Madingley Road, Cambridge, CB3 0HE, UK

Abstract: Conjugated polymers now provide a class of processible, film-forming semiconductors and metals. We have worked on the development of the semiconductor physics of these materials by using them as the active components in a range of semiconductor devices. Polymer light-emitting diodes show particular promise, and recent developments in color range (red, green, and blue), efficiency (above 20 lumen/W for green emitters), and operating lifetime are discussed. Progress on their application to displays, with integration with active-matrix TFT drive, and with patterned deposition using inkjet printing techniques is also reviewed. The role played by interfaces between electrode and semiconducting polymer is also discussed.

INTRODUCTION

Since the first report of metallic conductivities in "doped" polyacetylene in 1977 [1] the science of electrically conducting polymers has advanced very rapidly. More recently, as high-purity polymers have become available, a range of semiconductor devices have been investigated; these include transistors [2–5], photodiodes [6,7], and light-emitting diodes (LEDs) [8–10]. The potential for commercialization is perceived to be high for these semiconductor devices because they are seen to compete in application areas where the market can bear the costs of development. In particular, polymer LEDs now show attractive device characteristics, including efficient light generation, and there are several development programs now set up to establish procedures for manufacture. The principal interest in the use of polymers lies in the scope for low-cost manufacturing, using solution-processing of film-forming polymers.

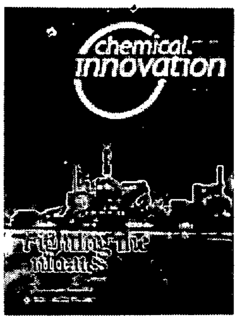
In parallel with these development activities, much progress has been made in the understanding of the underlying science that controls the properties of these devices. In comparison with inorganic semiconductors, relatively little is known about the electronic properties of these materials; even the nature of the semiconductor excitations remains controversial. There has been considerable progress made recently in resolving some of those issues that determine the limits to device performance, and there have been several recent reviews [11–13]. In this paper, I review progress that has been made in the use of conjugated polymers in LEDs and in photovoltaic diodes.

ELECTROLUMINESCENCE

Operation of polymer light-emitting diodes

Conjugated polymers derive their semiconducting properties from having delocalized π-electron bonding along the polymer chain. The π bonding and π^* antibonding orbitals form delocalized valence and conduction wavefunctions, which support mobile charge carriers. Electroluminescence from conjugated polymers was first reported [8] using poly(phenylene vinylene) (PPV), as the single semiconductor layer between metallic electrodes, as is illustrated in Fig. 1.

*Lecture presented at the XVIIIth IUPAC Symposium on Photochemistry, Dresden, Germany, 22–27 July 2000. Other presentations are published in this issue, pp. 395–548.



ENABLING SCIENCE

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Hot Articles

Table of Contents

Conjugated polymers: New materials for photovoltaics

Polymers can be made to act like semiconductors, giving a new meaning to "catching some rays".

Gordon G. Wallace
Paul C. Dastoor
David L. Officer
Chee O. Too

Polymeric photovoltaics present the tantalizing possibility of producing coatings that function as sunlight-harvesting paints on roofs or even as an integral part of fabrics to produce electricity from sunlight. MacDiarmid, Shirakawa, and Heeger (*1*) brought the unique properties of conjugated polymers to the fore in 1977 when they discovered that chemical doping of these materials resulted in increases in electronic conductivity over several orders of magnitude. Since then, electronically conducting materials based on conjugated polymers have been applied in diverse items such as sensors, biomaterials, light-emitting diodes, polymer actuators, and corrosion protection agents. In this article, we review the principles behind generating the photovoltaic effect in conjugated polymers, consider progress to date, and discuss the exciting possibilities that lie before us.

Conjugated polymers

Conjugated polymers have a framework of alternating single and double carbon–carbon (sometimes carbon–nitrogen) bonds (Figure 1). Single bonds are referred to as σ-bonds, and double bonds contain a σ-bond and a π-bond. All conjugated polymers have a σ-bond backbone of overlapping sp^2 hybrid orbitals. The remaining out-of-plane p_z orbitals on the carbon (or nitrogen) atoms overlap with neighboring p_z orbitals to give π-bonds

Although the chemical structures of these materials are represented by alternating single and double bonds, in reality, the electrons that constitute the π-bonds are delocalized over the entire molecule. For this reason, polyaniline (PAn) and poly(*N*-vinylcarbazole) (PVCZ) are considered to be conjugated polymers, with the nitrogen p_z orbital assisting the delocalization of the π-electrons. In some conjugated polymers such as polyacetylene (PA) and PAn, delocalization results in a single (degenerate) ground state, whereas in other polymers the alternating single and double bonds lead to electronic structures of varying energy levels.

The behavior of conjugated polymers is dramatically altered with chemical doping. Generally, polymers such as polypyrrole (PPy) are partially oxidized to produce p-doped materials: